DOCUMENT RESUME

ED 115 472 SE 019 099

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TITLE The Relation between Required Objective Attainment and Student Selected Objectives: Two Components in an Instructional Model for Individualization.
PUB DATE Apr 75
NOTE 18p.; Paper presented at the Annual Meeting of the American Educational Research Association (Washington, D.C., March 30-April 3, 1975). Occasional marginal legibility
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EDRS PRICE MF-$0.76 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS *Behavioral Objectives; Cognitive Processes; Educational Research; *Individualized Instruction; *Instruction; *Physics; Science Education; Secondary Education; *Secondary School Science; Student Participation
IDENTIFIERS Research Reports

ABSTRACT

This study was conducted to determine if the inclusion of a required objective attainment condition would increase student achievement when instruction was structured by a program that utilized student selected objectives. The following null hypothesis was formulated: no significant difference exists in the number of student selected objectives achieved between the mastery and non-mastery treatment groups. Each group consisted of 20 secondary school physics students. Criterion-referenced tests were administered to each student to determine if the selected objectives had been achieved. If a student in the mastery treatment group failed to reach the proficiency level of an objective, a related activity was substituted and assessed before going on to unit two. A student in the non-mastery treatment group was not permitted to undergo remediation and reassessment but proceeded to unit two. Analysis revealed that students of both treatments selected objectives with the same proficiency levels but different cognitive levels. (LS)

The Relation Between Required Objective Attainment and Student Selected Objectives: Two Components in an Instructional Model for Individualization

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Abstract

This study was conducted to determine if the inclusion of a required objective attainment condition would increase student achievement when instruction was structured by a program that utilized student selected objectives. Two treatment groups provided the dependent variable data (student objectives achieved), which subsequently was analyzed by a contingency table. A significant difference in achievement between the two groups was found. Further analyses revealed that Ss of both treatments selected objectives with the same proficiency levels but different cognitive levels. A significant treatment group difference in achievement was found to occur in one of the six cognitive level classifications.

Paper prepared for AERA Conference.
March 30-April 3, 1975, Washington, D.C.

Instructional programs that provide students with an opportunity to select behavioral objectives for each learning unit are espoused in the literature on individualized instruction (6, 7). Johnson (7) has suggested that student involvement in selecting or in some cases developing behavioral objectives encourages a sense of purpose and personal commitment on the part of the student. One study on this topic determined that students chose more factual objectives and a greater number of objectives per unit than the teacher selected for them. Moreover, a comparison of the objectives thought to be important by the teachers and those considered important by their students were quite different. However, when the student and teacher conferred on the respective objectives selected the initial differences were usually resolved (1).

Attention to the topic of student selected objectives is becoming more evident in the literature, but with the exception of the preceding study, empirical evidence supporting this practice is rather diminutive.

PROBLEM

This investigation was designed to assess the number of behavioral objectives achieved by secondary school physics students who were provided the opportunity to select their instructional objectives before the instructional activities commenced. More specifically, the purpose of this investigation was to ascertain if an instructional model which mandated the achievement of all student selected unit objectives before proceeding to the succeeding instructional unit affected the number of objectives that were achieved by secondary school physics students. Prompted by this concern the following null hypothesis was formulated for the purpose of statistical analysis in this investigation:

> No significant difference exists in the number of student selected objectives achieved between the mastery and non-mastery treatment groups.

Student Selection of Objectives

Students were provided with objective planning sheets (Figure 1) for each content objective to facilitate the process of selecting objectives. The proper classification of the cognitive statements on each objective planning sheet was validated by a faculty member from the curriculum and instruction department, and a secondary school physics teacher.

Insert Figure 1

The student selected one cognitive level and one proficiency level from each objective planning sheet for each objective. These selections were then reviewed by the teacher. If the teacher felt the student had selected a level above or below his capabilities, he advised the student to reconsider the choice. However, the student was permitted to make the final decision concerning his objectives.

PROCEDURE

General Description

The investigation was conducted in a senior high school with an enrollment exceeding two two thousand students. One instructor was responsible for directing the learning activities in physics to three scheduled classes. Each class was fifty minutes in length and class enrollments were nearly equivalent, i.e., first period, n=24, second period, n=23, third period, n=20. Of these, two classes were selected by a table of random numbers (14) to serve as the treatment groups, i.e., mastery (n=24) and non-mastery (n=23).

An orientation phase of twelve weeks (60 class periods) duration was utilized to enable students in both treatment groups to become accustomed to instructional techniques utilized in this investigation that were unique from preceding instructional modes. These techniques included: selecting behavioral objectives from objective planning sheets, and utilizing a computer printed assignment and activity guide. More important in some

respects was the fact that students in both groups were encouraged to assume responsibility for their learning during this phase of the study. Content from Chapters 5, 6, 14, 15 and 16 of the P.S.S.C. text (9) served as the primary source of cognitive material during this period.

A five week (25 class periods) experimental phase commenced for both treatment groups at the conclusion of the orientation phase. The beginning of the experimental phase was signified by the selection of unit one behavioral objectives by the students. The concepts, principles, and examples of two chapters in the P.S.S.C. text, i.e., 19 and 20 (9) served as the primary references for the two instructional units in the investigation. Regardless of group membership, each student had a personal copy of the textbook, laboratory manual, and a computer printed assignment and activity guide for each instructional unit. Additional classroom equipment for individual use in both treatment groups included: six cassett tape recorders with headsets and six tapes for each lesson, five sets of laboratory apparatus for each experiment (Expt 20, Changes in Velocity...; Expt 21, The Dependence of Acceleration..; Expt 22, Inertial and Gravitational Mass; Expt 24, Centripetal Force), six sets of reference materials, i.e., Unit I and II Project Physics Readers (11, 12) six sets of programmed materials and two sets of solutions to assigned problems. Teacher led discussions and P.S.S.C. films ("Forces," "Falling Bodies," and "Frames of Reference") were scheduled by the instructor as the students requested them and as the film schedule dictated. No attempt was made to determine what percent of class time each student spent with the different activities suggested in his guide.

Unit evaluations were conducted within each treatment group based upon the criteria established by the behavioral objectives selected by each student. These evaluations, termed criterion-referenced tests were administered to each student to determine if the selected objectives had been achieved. The difference in experimental treatments occurred at this point in the investigation. If a student in the mastery treatment group failed to

reach the proficiency level of an objective, remediation of an instructional activity related to that objective was undertaken by the student. After completing the alternate activity, the student underwent reassessment on the objective with a different posttest. The remediation-reassessment sequence continued for each student until all objectives in unit one were achieved. After attaining all of the objectives in unit one, the student then selected the behavioral objectives for unit two. In contrast, a student in the non-mastery treatment group was not permitted to undergo remediation and reassessment if he initially failed to reach the proficiency levels of the objectives selected for unit one. Upon taking the posttest for unit one, the student in this treatment proceeded with the selection of behavioral objectives for unit two.

The conclusion of the experimental phase was signified by the administration of the criterion-referenced tests of unit two. Because the temporal span of twenty-five days was held constant for the experimental phase, all students in both treatment groups were required to take their unit two tests on or before the last day of the experimental phase of the investigation. No remediation-reassessment procedures were allowed for students in either treatment group after the unit two criterion-referenced tests were administered.

Instruments

Criterion-referenced tests were compiled from test item sets referenced to each cognitive level of each objective planning sheet. Considering both units, sixty-six different sets of test items were developed or selected from the text (9) and teacher's guide (10). The content-validity of the test item sets based upon the cognitive levels on the objective planning sheets were attended to by submitting each test item set - cognitive level dyad to a panel. This panel evaluated item clarity and correspondence of cognitive levels measured by the test items to the behaviors stated in the objective.

Each student test was potentially different, since the selected cognitive levels from the planning sheets determined the test item sets that were

compiled into a unit test. Because of the myriad of possible tests, a computer support system was developed to compile and print each student test.

Reliability estimates were not determined, since this would have necessitated the administration of sixty-six tests to pilot groups to obtain reliability values for each test. Thirty different tests were possible for unit one since the unit was organized around five content objectives, each containing six cognitive levels (2). Unit two posited six content objectives, thus thirty-six different tests were possible. In addition, a number of writers (3, 5, 15) have expressed concern about the integrity of norm referenced methods to determine reliability coefficients for criterion-referenced tests. For these reasons, and the limited resources available reliability measures were not determined for the student tests administered.

Statistical Procedures and Variables

The independent variable in this investigation consisted of the treatments, i.e., mastery and non-mastery. The 2x2 chi-square statistic (8) was utilized to test the hypothesis formulated for this investigation because the dependent variable, the number of objectives mastered, was nominal data. Since nominal data does not meet the requirements of parametric statistics, a nonparametric procedure was used (4).

Data Analysis and Findings

Table 1 summarizes the significant finding resulting from the application of the 2x2 chi-square statistic to the number of objectives mastered by both treatment groups.

Insert Table 1

Stimulated by the significant chi-square value, additional research questions were formulated to determine if the variation in objectives selected in the treatment groups accounted for differences in the number of objectives achieved.

Eight contingency tables were used to seek answers to the expostfacto

questions. These included: a 3x2 contingency table based on the proficiency levels selected, a 6x2 contingency table based on the cognitive levels selected, and six 2x2 contingency tables based on the objectives achieved in each cognitive level by each treatment.

Tables 2, 3, and 4 present the results of the analyses and indicate that differences did occur between the treatment groups in two of the comparisons.

Insert Table 2

Table 2 displays the frequency data and the resulting non-significant χ^2 value resulting from the comparison of the proficiency levels selected by students in both treatment groups. It is interesting to note that the majority of students in both treatment groups chose the 80% proficiency level. Although not shown in Table 2, students who chose the 100% level also selected the higher cognitive levels i.e., synthesis and evaluation.

Insert Table 3

In contrast to the similarity of the proficiency levels selected by students of both treatment groups, Table 3 indicates a significant difference in the alternate cognitive levels selected by the students of each treatment group. The cognitive levels whose frequencies exhibited the greatest disparity between treatment groups were the synthesis and evaluation levels. Again the trend of both treatment groups appeared to be that students chose the higher cognitive levels i.e., application, analysis, synthesis, and evaluation, rather than knowledge or comprehension level objectives.

Insert Table 4

Table 4 contains the comparisons of objectives mastered in each cognitive category. The most pronounced difference reflected by the χ^2 values was the comparison of objectives mastered in the analysis category. Although

more students in the non-mastery group selected the analysis category, significantly more students in the mastery group achieved their analysis category objectives than did their peers in the non-mastery group. The frequency of objectives achieved by the mastery group exceeded the number of objectives achieved by the non-mastery group in three of the six categories. Exceptions included the knowledge category where no objectives were selected by either group, the comprehension category where both groups achieved the same number of objectives, and the evaluation category where the non-mastery group achieved the greater number of objectives.

CONCLUSIONS

The following conclusions are directly related to the sample population of high school physics students who participated in this investigation. If the sample population is representative, as the investigators have assumed, the following conclusions have general applicability to other high school student populations in other school systems:

1. The achievement of student selected objectives in secondary school physics is enhanced by the inclusion of a rule in the instructional model that requires mastery of all objectives before the student proceeds with ensuing units.
2. The cognitive levels selected by secondary school physics students for their objectives are influenced by the inclusion of a rule in the instructional model that requires mastery of all objectives before the student proceeds with ensuing units.
3. The proficiency levels selected by secondary school physics students for their objectives are not influenced by the inclusion of a rule in the instructional model that requires mastery of all objectives before the student proceeds with ensuing units.

Discussion

Although the treatment groups were selected by random techniques, group membership was not determined randomly. Intact groups, developed from enrollment practices used in the school system, participated in the investigation. Therefore, extrapolation of these conclusions to other classes, teachers, and courses should be done with discretion.

The data collected during this investigation identified trends common to both treatment groups. Students in both groups demanded a great deal of themselves, as evidenced by their selection of high cognitive levels and high proficiency levels. This observation is contrary to the findings reported by Bianchi, i.e., students tended to choose knowledge objectives (1). One explanation for this discrepancy is that secondary school physics students are very goal oriented and seek to achieve difficult academic standards.

The primary difference between the two treatment groups, i.e., number of objectives achieved, cannot be explained by stating that students in the non-mastery group selected more difficult objectives. With the exception of the evaluation cognitive level, students in the mastery treatment group achieved more objectives than the non-mastery group in each cognitive level where objectives were selected. In the case of the proficiency levels, both groups selected approximately the same number from each level.

It is plausible to suggest that large error variance influenced the number of objectives achieved thus producing a spurious difference in the measurement of achievement. This consideration has some merit because of the absence of reliability and validity values for each criterion-referenced test used in this investigation. However, criterion-referenced tests for individual students in both treatment groups were developed from the same bank of test item sets, and to this degree students in both treatment groups were evaluated with equally valid instruments.

Another reason for the observed difference in achievement between

the treatment groups appears to be predicated upon the relationship between the instructional units. In this investigation, unit one provided prerequisite information for unit two. Students failing to achieve the objectives in unit one were placed in an unfavorable position in unit two. If the student failed to achieve an objective in unit one on a concept that was taken up again in unit two the opportunity for failure was increased. Conversely, the student in the mastery group under similar circumstances was required to review and achieve the objective before proceeding to the ensuing unit. A negating factor for students in the mastery group was the amount of time needed for reviewing the material before achieveing the objective. The results of this investigation indicate that more is to be gained if the student does master the objective before proceeding. This generalization assumes that instructional units are sequential in content organization.

Figure 1

OBJECTIVE PLANNING SHEET

5. Content Objective. The content of this objective is related to simple harmonic motion.

Cognitive Levels. I will be able to:

1. Knowledge - identify the characteristics and equations which describe simple harmonic motion and the period of oscillation.
2. Comprehension - relate the equations for circular motion to those of simple harmonic motion.
3. Application - use the equations ($F = -Kx$, $T = 2\pi\sqrt{\frac{m}{K}}$, $T = 2\pi\sqrt{\ell/g}$) to determine the period and displacement of a pendulum.
4. Analysis - relate the motion of an object attached to a suspended spring to the equations $F = -Kx$ and $T = 2\pi\sqrt{\frac{m}{K}}$.
5. Synthesis - compile a set of characteristics which illustrate why simple harmonic motion is more complex than circular motion.
6. Evaluation - describe analytically the relationship between $F = ma$ and $F = -Kx$.

Proficiency Levels.

1. I will be expected to demonstrate complete mastery of this objective either by a verbal presentation or by a written explanation. If problems are involved, written solutions are required.
2. I will be expected to demonstrate 80% mastery of this objective through explanations and problem solutions both oral and written.
3. I will be expected to demonstrate 60% mastery of this objective through problem solutions and explanations both oral and written.

Table 1

Chi-Square Value and Frequency of Objectives

Achieved and Not Achieved by the Treatment Groups

Group	Objectives Mastered	Objectives Not Mastered	Total Assigned
Mastery Group	192	72	264
Non-Mastery Group	134	119	253
Total	326	191	517

Chi-Square Value = 20.79

$P.01 < \chi^2$

Table 2

Frequency of Proficiency Levels Selected by Students in Mastery and Non-Mastery Treatment Groups

Group	Proficiency Level Selected 60%	80%	100%	Total
Mastery Group	14	175	75	264
Non-Mastery Group	22	163	68	253
Total	36	338	143	517

Chi-Square Value = 1.80

$\chi^2 < P.05$

Table 3

Frequency of Cognitive Levels Selected by Students in Mastery and Non-Mastery Treatment Groups

	Cognitive Levels Selected*						
	KNO	COM	APL	ANA	Syn	EVA	Total
Mastery Group	0	4	45	121	67	27	264
Non-Mastery Group	0	3	35	133	31	51	253
Total	0	7	80	254	98	78	517

Chi-Square Value = 24.53 df = 5

$P.001 < \chi^2$

*KNO = Knowledge APL = Application Syn = Synthesis

COM = Comprehension ANA = Analysis EVA = Evaluation

Table 4

Chi-Square Values and Frequency of Objectives Achieved

Cognitive Level	Mastery Group		Non-Mastery Group		χ^2	P
	Objectives Achieved	Objectives Not Achieved	Objectives Achieved	Objectives Not Achieved		
Knowledge	0	0	0	0	0.00	N.S.
Comprehension	2	2	2	1	0.11	N.S.
Application	30	15	18	17	1.91	.20
Analysis	86	35	58	75	19.50	.001
Synthesis	49	18	17	14	3.21	.10
Evaluation	25	2	39	12	2.11	.20

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